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(54) Title: **ANTI-CHEMOKINE AND ASSOCIATED RECEPTOR ANTIBODIES AND USES FOR INHIBITION OF INFLAMMATION.**

(57) Abstract: It is possible to inhibit inflammatory processes by administration of antibodies to chemokines. Identification of chemokines which are over-produced makes it possible to block specific chemokine activity using antibodies to the over-expressed chemokines.

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APPLICATION FOR LETTERS PATENT

Title: Anti-Chemokine and Associated Receptor Antibodies and Uses for Inhibition of Inflammation.

5 **Field of the Invention.**

This invention relates to antibodies or the use of antibodies directed against certain chemokines. The antibodies block high-affinity interactions leading to inflammation.

10 **Background of the Invention.**

Despite recent advances in studies related to the inflammation process, therapies for treatment of chronic inflammatory diseases have remained elusive. This is perhaps a result of the many and complex factors in the host that initiate and maintain inflammatory conditions. Current therapies have disadvantages associated with them, including the suppression of the immune system that can render the host more susceptible to bacterial, viral and parasitic infections. For example, use of steroids is a traditional approach to chronic inflammation treatment. Such treatment can lead to changes in weight and suppression of protective immunity. Advances in biotechnology have promoted the development of targeted biologicals with fewer side effects. To improve inflammatory disease treatment, technologies that alter and control the factors generated by cells of both innate and adaptive immunity systems need to be developed.

Host cells have surface receptors that associate with ligands to signal and regulate host cell activities. Administration of anti-TNF- α antibody or soluble TNF- α receptor has been shown to inhibit inflammatory diseases. Unfortunately, the side effects associated with this treatment can result in an increased risk of infections (e.g., tuberculosis) and other adverse reactions by mechanisms not fully understood. Similarly, antibody therapies focused on membrane bound molecules like CD40 have a propensity for inhibiting inflammation and graft-host diseases. While other targeted host cell therapies to prevent inflammatory diseases-

es are being developed, there is no known single surface or secreted factor that will stop all inflammatory diseases. Consequently, the development of therapies to exploit newly identified specific host cell targets is required.

5 A variety of pathogens or toxins activate macrophages, neutrophils, T cells, B cells, monocytes, NK cells, Paneth and crypt cells, as well as epithelial cells shortly after entry into the mucosa. Chemokines are a superfamily of small, cytokine-like proteins that are resistant to hydrolysis, promote neovascularization or endothelial cell growth inhibition, induce cytoskeletal rearrangement, activate or inactivate lymphocytes, and mediate chemotaxis through interactions with G-protein-coupled receptors. Chemokines can mediate the growth and migration of host cells that express their receptors. The cellular mechanisms responsible for the function of chemokines are often, but not entirely, Ca^{2+} flux dependent and pertussis toxin-sensitive. However, the precise mechanisms for chemokine-mediated events are not known.

20 Summary of the Invention

The present invention provides a means of inhibiting inflammation by administering anti-chemokine antibodies. Exemplified are anti -CXCL9, -CXCL10, -CXCL11, -CCRL1, -CCRL2, -CCR5, -CCL1, -CCL2, -CCL3, -CCL4, -CCL4L1, -CCL5, -CCL7, -CCL8, -CCL14-1, -CCL14-2, -CCL14-3, -CCL15-1, -CCL15-2, -CCL16, -CCL19, -CCL23-1, -CCL23-2, -CCL24, -CCL26, -CCR6, -CCL20, and -CCL25, -CCL25-1, -CCL25-2 antibodies. These chemokines are known. The Genbank accession numbers are provided herein. The invention utilizes antibodies or functional fragments thereof that bind to the target chemokines. The antibodies or antigen-binding fragment(s) bind to epitope(s) or peptide(s) that consists of 10 to 15 amino acids from sequences 1 through 30 (accession numbers in NIH-NCBI Genbank given below) of the target chemokines. Antibodies which act as modulators can administered mucosally or systemically.

The antibody, antibodies, or antigen-binding fragment

or fragments can be isolated from the serum of immunized mammalian hosts, from cultures of immortalized cell lines and tissues such as hybridomas, lymphoblastoid or cells generated by methods of recombinant molecule biology. For increased effectiveness, fragments may be conjugated or linked to other peptides, proteins, nucleic acid sequences, vitamins, complex or simple carbohydrates, or other suitable carrier molecules.

Antibodies or antigen-binding fragments with specificity for functional mutant or variant mammalian chemokines are appropriate. These mutations or polymorphisms occur in nature or can be induced by recombinant molecular biological methods to generate single, multiple, or continuous amino acid residues, described in sequences 1 through 30, that are deleted, added, and/or substituted for other or no amino acids.

The mucosal means of application include oral, intranasal, ocular, intravaginal, rectal, and/or intraurethral administration in liquid or particulate form or on solid supports. Systemic means of application include parenteral, intravenous, or intramuscular administration in liquid or particulate form.

Detailed Description of the Invention

The invention provides methods of identifying, evaluating and treating a subject suffering from conditions arising from inflammatory processes, including anaphylaxis and septic shock, arthritis (e.g., osteoarthritis, rheumatoid, psoriatic), asthma, allergies (e.g., drug, insect, plant, food), atherosclerosis, delayed type hypersensitivity, dermatitis, diabetes (e.g., mellitus, juvenile onset), graft rejection, inflammatory bowel diseases (e.g., Crohn's disease, ulcerative colitis, enteritis), interstitial cystitis, multiple sclerosis, myasthenia gravis, Grave's disease, Hashimoto's thyroiditis, pneumonitis, prostatitis, psoriasis, nephritis, pneumonitis, chronic obstructive pulmonary disease, chronic bronchitis rhinitis, spondyloarthropathies, scleroderma, systemic lupus erythematosus, or thyroiditis

using the said embodiments. As a result one or more of inflammatory processes including host cell migration or excretion.

It has now been demonstrated, using as examples anti
5 -CXCL9, -CXCL10, -CXCL11, -CCRL1, -CCRL2, -CCR5, -CCL1,
-CCL2, -CCL3, -CCL4, -CCL4L1, -CCL5, -CCL7, -CCL8, -CCL14-1,
-CCL14-2, -CCL14-3, -CCL15-1, -CCL15-2, -CCL16, -CCL19,
-CCL23-1, -CCL23-2, -CCL24, -CCL26, -CCR6, -CCL20, and
-CCL25, -CCL25-1, -CCL25-2 antibodies, that it is possible
10 to inhibit the inflammatory cell activation, migration or
chemotaxis of the by inflammatory processes.

Materials and Methods

Primer Design

Messenger RNA sequences for CXCL9, CXCL10, CXCL11,
15 CCRL1, CCRL2, CCR5, CCL1, CCL2, CCL3, CCL4, CCL4L1, CCL5,
CCL7, CCL8, CCL14-1, CCL14-2, CCL14-3, CCL15-1, CCL15-2,
CCL16, CCL19, CCL23-1, CCL23-2, CCL24, CCL26, CCR6, CCL20,
and CCL25, CCL25-1, CCL25-2 were obtained from the NIH-NCBI
gene bank database (Sequences 31 through 60, accession
20 numbers given later). Primers were designed using the
BeaconJ 2.0 computer program. Thermodynamic analysis of the
primers was conducted using computer programs: Primer Pre-
mierJ and MIT Primer 3. The resulting primer sets were
compared against the entire human genome to confirm speci-
25 ficity.

Real Time PCR analysis

Lymphocytes or inflamed tissues were cultured in RPMI-
1640 containing 10% fetal calf serum, 2% human serum, sup-
plemented with non-essential amino acids, L-glutamate, and
30 sodium pyruvate (complete media). Additionally, primary
inflammatory and normal-paired matched tissues were obtained
from clinical isolates (Clinomics Biosciences, Frederick, MD
and UAB Tissue Procurement, Birmingham, AL). Messenger RNA
(mRNA) was isolated from 10^6 cells using TriReagent (Molecu-
35 lar Research Center, Cincinnati, OH) according to manufac-
turers protocols. Potential genomic DNA contamination was
removed from these samples by treatment with 10 U/ μ l of

5 RNase free DNase (Invitrogen, San Diego, CA) for 15 minutes
at 37 °C. RNA was then precipitated and resuspended in RNA
Secure (Ambion, Austin, TX). cDNA was generated by reverse
transcribing approximately 2 µg of total RNA using Taqman7
reverse transcription reagents (Applied Biosystems, Foster
City, CA) according to manufacturers protocols. Subsequent-
ly, cDNA's were amplified with specific human cDNA primers,
to CXCL9, CXCL10, CXCL11, CCRL1, CCRL2, CCR5, CCL1, CCL2,
CCL3, CCL4, CCL4L1, CCL5, CCL7, CCL8, CCL14-1, CCL14-2,
10 CCL14-3, CCL15-1, CCL15-2, CCL16, CCL19, CCL23-1, CCL23-2,
CCL24, CCL26, CCR6, CCL20, and CCL25, CCL25-1, CCL25-2,
using SYBR7 Green PCR master mix reagents (Applied Bio-
systems) according to manufacturers protocol. The level of
copies of mRNA of these targets were evaluated by real-time
15 PCR analysis using the BioRad Icyler and software (Hercu-
les, CA). Anti-sera preparation

The 15 amino acid peptides from chemokines CXCL9,
CXCL10, CXCL11, CCRL1, CCRL2, CCR5, CCL1, CCL2, CCL3, CCL4,
CCL4L1, CCL5, CCL7, CCL8, CCL14-1, CCL14-2, CCL14-3,
20 CCL15-1, CCL15-2, CCL16, CCL19, CCL23-1, CCL23-2, CCL24,
CCL26, CCR6, CCL20, and CCL25, CCL25-1, CCL25-2 (Sequences 1
through 30) were synthesized (Sigma Genosys, The Woodlands,
TX) and conjugated to hen egg lysozyme (Pierce, Rockford,
IL) to generate the antigens for subsequent immunizations
25 for anti-sera preparation or monoclonal antibody generation.
The endotoxin levels of chemokine peptide conjugates were
quantified by the chromogenic Limulus amebocyte lysate assay
(Cape Cod, Inc., Falmouth, MS) and shown to be < 5 EU / mg.
100 µg of the antigen was used as the immunogen together
30 with complete Freund's adjuvant Ribi Adjuvant system (RAS)
for the first immunization in a final volume of 1.0 ml.
This mixture was administered in 100 µl aliquots on two
sites of the back of the rabbit subcutaneously and 400 µl
intramuscularly in each hind leg muscle. Three to four weeks
35 later, rabbits received 100 µg of the antigen in addition to
incomplete Freund's adjuvant for 3 subsequent immunizations.
Anti-sera were collected when antibody titers reached

1:1,000,000. Subsequently, normal or anti-sera were heat-inactivated and diluted 1:50 in PBS.

Monoclonal antibody preparation

The 15 amino acid peptides from chemokines CXCL9, CXCL10, CXCL11, CCRL1, CCRL2, CCR5, CCL1, CCL2, CCL3, CCL4, CCL4L1, CCL5, CCL7, CCL8, CCL14-1, CCL14-2, CCL14-3, CCL15-1, CCL15-2, CCL16, CCL19, CCL23-1, CCL23-2, CCL24, CCL26, CCR6, CCL20, and CCL25, CCL25-1, CCL25-2 (Sequences 1 through 30) were synthesized (Sigma Genosys) and conjugated to hen egg lysozyme (Pierce) to generate the Antigen® for subsequent immunizations for anti-sera preparation or monoclonal antibody generation. The endotoxin levels of chemokine peptide conjugates were quantified by the chromogenic Limulus amebocyte lysate assay (Cape Cod, Inc., Falmouth, MS) and shown to be <5 EU/mg. 100 µg of the antigen was used as the immunogen together with complete Freund's adjuvant Ribi Adjuvant system (RAS) for the first immunization in a final volume of 200 µl. This mixture was subcutaneously administered in 100 µl aliquots at two sites of the back of a rat, mouse, or immunoglobulin-humanized mouse. Two weeks later, animals received 100 µg of the antigen in addition to incomplete Freund's adjuvant for 3 subsequent immunizations. Serum were collected and when anti -CXCL9, -CXCL10, -CXCL11, -CCRL1, -CCRL2, -CCR5, -CCL1, -CCL2, -CCL3, -CCL4, -CCL4L1, -CCL5, -CCL7, -CCL8, -CCL14-1, -CCL14-2, -CCL14-3, -CCL15-1, -CCL15-2, -CCL16, -CCL19, -CCL23-1, -CCL23-2, -CCL24, -CCL26, -CCR6, -CCL20, and -CCL25, -CCL25-1, -CCL25-2 antibody titers reached 1:2,000,000, hosts were sacrificed and splenocytes were isolated for hybridoma generation.

B cells from the spleen or lymph nodes of immunized hosts were fused with immortal myeloma cell lines (e.g., YB2/0). Hybridomas were next isolated after selective culturing conditions (i.e., HAT-supplemented media) and limiting dilution methods of hybridoma cloning. Cells that produce antibodies with the desired specificity were selected using ELISA. Hybridomas from normal rats or mice were humanized with molecular biological techniques in common use.

After cloning a high affinity and prolific hybridoma, antibodies were isolated from ascites or culture supernatants and adjusted to a titer of 1:2,000,000 and diluted 1:50 in PBS.

5 **Anti-sera or monoclonal antibody treatment**

Knockout or transgenic mice (8 to 12 weeks old, Charles River Laboratory, Wilmington, MA) that spontaneous- or when treated- develop inflammatory diseases were treated with 200 μ l intraperitoneal injections of either anti-sera or monoclonal antibodies specific for each of the chemokines every three days. The inflammatory disease state of the host was next monitored for progression or regression of disease.

10 **Cytokine analysis by ELISA**

The serum level of IL-2, -IL-6, -TNF- α , and -IFN- γ were determined by ELISA, following the manufacturers instructions (E-Biosciences, San Diego, CA). Plates were coated with 100 μ l of the respective capture antibody in 0.1 M bicarbonate buffer (pH 9.5) and incubated O/N at 4°C. After aspiration and washing with wash buffer, the wells were blocked with assay diluent for 1 hour at RT. Samples and standards were added and incubated for 2 hours at RT. Next, 100 μ l of detection antibody solutions were added and incubated for 1 hour. 100 μ l of avidin-HRP solution was added and incubated for 30 minutes. Subsequently, 100 μ l Tetramethylbenzidine (TMB) substrate solution was added and allowed to react for 20 minutes. 50 μ l of the stop solution was added and plates were read at 450 nm. The cytokine ELISA assays were capable of detecting > 15 pg/ml for each assay.

25 **Cytokine analysis by multiplex cytokine ELISA**

30 The T helper cell derived cytokines, IL-1 α , IL-1 β , IL-2, IL-12, IFN- γ , TNF- α , in serum were also determined by Beadlyte mouse multi-cytokine detection system kit provided by BioRad, following manufacturer instructions. Filter bottom plates were rinsed with 100 μ l of bio-plex assay buffer and removal using a Millipore Multiscreen Separation Vacuum Manifold System (Bedford, MA), set at 5 in Hg. IL-1 α , IL-1 β , IL-2, IL-12, IFN- γ , TNF- α beads in assay buffer were

35

added into wells. Next, 50 μ l of serum or standard solution were added and the plates were incubated for 30 minutes at RT with continuous shaking (setting 3) using a Lab-Line Instrument Titer Plate Shaker (Melrose, IL), after sealing the plates. The filter bottom plates were washed 2 times, as before, and centrifuged at 300 x g for 30 seconds. Subsequently, 50 μ l of anti-mouse IL-1 α , IL-1 β , IL-2, IL-12, IFN- γ , TNF- α antibody-biotin reporter solution was added in each well followed by incubation with continuous shaking for 30 minutes followed by centrifugation at 300 x g for 30 seconds. The plates were washed 3 times with 100 μ l of bio-plex assay buffer as before. Next, 50 μ l streptavidin-phycoerythrin solution was added to each well and incubated with continuous shaking for 10 minute at RT. 125 μ l of bio-plex assay buffer was added and Beadlyte readings were measured using a Luminex1 instrument (Austin, TX). The resulting data was collected and calculated using Bio-plex1 software (Bio-Rad). The cytokine Beadlyte assays were capable of detecting >5 pg/ml for each analyte.

Serum amyloid protein A (SAA) ELISA

The SAA levels were determined by ELISA using a kit supplied by Biosource International, (Camarillo, CA). Briefly, 50 μ l of SAA-specific monoclonal antibody solution was used to coat micro-titer strips to capture SAA. Serum samples and standards were added to wells and incubated for 2 hours at RT. After washing in the assay buffer, the HRP-conjugated anti-SAA monoclonal antibody solution was added and incubated for 1 hour at 37°C. After washing, 100 μ l Tetramethylbenzidine (TMB) substrate solution was added and the reaction was stopped after incubation for 15 minutes at RT. After the stop solution was added, the plates were read at 450 nm.

Histology and pathology scoring

Fixed tissues were sectioned at 6 μ m, and stained with hematoxylin and eosin for light microscopic examination. The intestinal lesions were multi-focal and of variable severity, the grades given to any section of intestine took into

account the number of lesions as well as their severity. A score (0 to 4) was given, based on the following criteria: (Grade 0) no change from normal tissue. (Grade 1) 1 or a few multi-focal mononuclear cell infiltrates, minimal hyperplasia and no depletion of mucus. (Grade 2) lesions tended to involve more of the mucosa and lesions had several multi-focal, yet mild, inflammatory cell infiltrates in the lamina propria composed of mononuclear cells, mild hyperplasia, epithelial erosions were occasionally present, and no inflammation was noticed in the sub-mucosa. (Grade 3) lesions involved a large area of mucosa or were more frequent than Grade 2, where inflammation was moderate and often involved in the sub-mucosa as well as moderate epithelial hyperplasia, with a mixture of mononuclear cells and neutrophils. (Grade 4) lesions usually involved most of the section and were more severe than Grade 3 lesions. Additionally, Grade 4 inflammations were more severe and included mononuclear cell and neutrophils; epithelial hyperplasia was marked with crowding of epithelial cells in elongated glands. The summation of these score provide a total inflammatory disease score per mouse. The disease score could range from 0 (no change in any segment) to a maximum of 12 with Grade 4 lesions of segments.

Data Analysis

SigmaStat 2000 (Chicago, IL) software was used to analyze and confirm the statistical significance of data. The data were subsequently analyzed by the Student's t-test, using a two-factor, unpaired test. In this analysis, treated samples were compared to untreated controls. The significance level was set at $p < 0.05$.

Results

Semiquantitative RT-PCR identification of molecular targets

RT-PCR products obtained using CXCL9-, CXCL10-, CXCL11-, CCRL1-, CCRL2-, CCR5-, CCL1-, CCL2-, CCL3-, CCL4-, CCL4L1-, CCL5-, CCL7-, CCL8-, CCL14-1-, CCL14-2-, CCL14-3-, CCL15-1-, CCL15-2-, CCL16-, CCL19-, CCL23-1-, CCL23-2-, CCL24-, CCL26-, CCR6-, CCL20-, and CCL25-, CCL25-1-, CCL25-

2- specific primer sets did not cross react with other gene targets due to exclusion of primers that annealed to host sequences 31 - 60. The primers used produced different size amplicon products relative the polymorphisms that resulted in CCL4 versus CCL4L1, CCL14-1, CCL14-2, versus CCL14-3, CCL15-1 versus CCL15-2, CCL23-1 versus CCL23-2, and CCL25, CCL25-1, versus CCL25-2. To this end, RT-PCR analysis of tissue from subjects exhibiting anaphylaxis, arthritis (e.g., rheumatoid, psoriatic), asthma, allergies (e.g., drug, insect, plant, food), atherosclerosis, delayed type hypersensitivity, dermatitis, diabetes (e.g., mellitus, juvenile onset), graft rejection, inflammatory bowel diseases (e.g., Crohn's disease, ulcerative colitis, enteritis), multiple sclerosis, myasthenia gravis, pneumonitis, psoriasis, nephritis, rhinitis, spondyloarthropathies, scleroderma, systemic lupus, or thyroiditis revealed that CXCL9, CXCL10, CXCL11, CCRL1, CCRL2, CCR5, CCL1, CCL2, CCL3, CCL4, CCL4L1, CCL5, CCL7, CCL8, CCL14-1, CCL14-2, CCL14-3, CCL15-1, CCL15-2, CCL16, CCL19, CCL23-1, CCL23-2, CCL24, CCL26, CCR6, CCL20, and CCL25, CCL25-1, CCL25-2 were differentially expressed by inflammatory host cells.

In vivo inflammatory disease inhibition

Mammals that develop anaphylaxis, septic shock, arthritis (e.g., rheumatoid, psoriatic), asthma, allergies (e.g., drug, insect, plant, food), atherosclerosis, bronchitis, chronic pulmonary obstructive disease, delayed type hypersensitivity, dermatitis, diabetes (e.g., mellitus, juvenile onset), graft rejection, Grave's disease, Hashimoto's thyroiditis, inflammatory bowel diseases (e.g., Crohn's disease, ulcerative colitis, enteritis), interstitial cystitis, multiple sclerosis, myasthenia gravis, pneumonitis, psoriasis, nephritis, rhinitis, spondyloarthropathies, scleroderma, systemic lupus erythematosus, or thyroiditis were allowed to develop the inflammatory disease of interest. Antibodies directed against CXCL9, CXCL10, CXCL11, CCRL1, CCRL2, CCR5, CCL1, CCL2, CCL3, CCL4, CCL4L1, CCL5, CCL7, CCL8, CCL14-1, CCL14-2, CCL14-3, CCL15-1, CCL15-2, CCL16,

CCL19, CCL23-1, CCL23-2, CCL24, CCL26, CCR6, CCL20, or CCL25, CCL25-1, CCL25-2 differentially affected the progression and regression of inflammatory disease as determined by histological scoring and comparing pre- and post-treatment serum levels of IFN- γ , IL-1 α , IL-1 β , IL-6, IL-12, TNF- α , amyloid protein A. Antibodies directed towards CXCL9, CXCL-10, CXCL11, CCRL1, CCRL2, CCR5, CCL1, CCL2, CCL3, CCL4, CCL4L1, CCL5, CCL7, CCL8, CCL14-1, CCL14-2, CCL14-3, CCL15-1, CCL15-2, CCL16, CCL19, CCL23-1, CCL23-2, CCL24, CCL26, CCR6, CCL20, or CCL25, CCL25-1, CCL25-2 effectively lead to the both regression and impeding progression of inflammatory disease as determined by histological scoring and comparing pre- and post-treatment serum levels of IFN- γ , IL-1 α , IL-1 β , IL-6, IL-12, TNF- α , amyloid protein A.

As indicated previously, the chemokines used in the methods of the invention are known. The accession numbers for the protein sequences (Sequences 1-30) are as follows: CXCL9, (ACCESSION# NM_002416), CXCL10 (ACCESSION# NM_001565), CXCL11 (ACCESSION# NM_005409), CCRL1 (ACCESSION# NM_016557), CCRL2 (ACCESSION# NM_003965), CCR5 (ACCESSION# NM_000579), CCL1 (ACCESSION# NM_002981), CCL2 (ACCESSION# NM_002982), CCL3 (ACCESSION# XM_008450, NM_002983), CCL4 (ACCESSION# NM_002984), CCL4L1 (ACCESSION# AY079147), CCL5 (ACCESSION# NM_002985), CCL7 (ACCESSION# NM_006273), CCL8 (ACCESSION# NM_005623), CCL14-1 (ACCESSION# NM_004166), CCL14-2 (ACCESSION# NM_032962), CCL14-3 (ACCESSION# NM_032963), CCL15-1 (ACCESSION# NM_032964), CCL15-2 (ACCESSION# NM_004167), CCL16 (ACCESSION# NM_004590), CCL19 (ACCESSION# NM_006274), CCL23-1 (ACCESSION# NM_005064), CCL23-2 (ACCESSION# NM_145898), CCL24 (ACCESSION# NM_002991), CCL26 (ACCESSION# NM_006072), CCR6 (ACCESSION# U45984), CCL20 (ACCESSION# NM_004591), CCL25 (ACCESSION# O15444), CCL25-1 (ACCESSION# NM_005624), and CCL25-2 (ACCESSION# NM_148888).

For the cDNA sequences (sequences 31-60), the following

GenBank accession numbers apply:

CXCL9 (ACCESSION# NM_002416), CXCL10 (ACCESSION# NM_001565),
 CXCL11 (ACCESSION# NM_005409), CCRL1 (ACCESSION# NM_016557),
 CCRL2 (ACCESSION# NM_003965), CCR5 (ACCESSION# NM_000579),
 5 CCL1 (ACCESSION# NM_002981), CCL2 (ACCESSION# NM_002982),
 CCL3 (ACCESSION# XM_008450, NM_002983),
 CCL4 (ACCESSION# NM_002984), CCL4L1 (ACCESSION# AY079147),
 CCL5 (ACCESSION# NM_002985), CCL7 (ACCESSION# NM_006273),
 CCL8 (ACCESSION# NM_005623), CCL14-1 (ACCESSION# NM_004166),
 10 CCL14-2 (ACCESSION# NM_032962),
 CCL14-3 (ACCESSION# NM_032963),
 CCL15-1 (ACCESSION# NM_032964),
 CCL15-2 (ACCESSION# NM_004167),
 CCL16 (ACCESSION# NM_004590), CCL19 (ACCESSION# NM_006274),
 15 CCL23-1 (ACCESSION# NM_005064),
 CCL23-2 (ACCESSION# NM_145898),
 CCL24 (ACCESSION# NM_002991), CCL26 (ACCESSION# NM_006072),
 CCR6 (ACCESSION# U45984), CCL20 (ACCESSION# NM_004591),
 CCL25 (ACCESSION# O15444), CCL25-1 (ACCESSION# NM_005624),

20 As shown in the table, the particular chemokines which
 give rise to inflammatory diseases differ with the disease.
 They also differ among individuals. Hence, it is wise, when
 treating an individual, to identify the particular chemo-
 kines which are increased in the tissues of the patient.
 25 Using the antibodies produced against each of the chemokines
 and exposing the tissue samples from the patient to the
 particular antibodies, then evaluating the amount of anti-
 body/chemokine binding, it is possible to evaluate the level
 of expression for each chemokine and to administer to the
 30 patient the particular antibodies that will bind the exces-
 sive chemokine. This tailored approach to treatment of
 inflammatory disease is novel, and a particularly valuable
 aspect of the invention.

Table 1. Chemokine, Chemokine Receptor and Inflammatory Disease Association (dependent of stage of disease)

Disease	Chemokine	Chemokine Receptor
Allergies (Skin, Food & Respiratory)	CCL1, CCL2, CCL5, CCL7, CCL8, CCL11, CCL13, CCL17, CCL22, CCL24, CCL25, CCL26	CCR3, CCR4, CCR8, CCR9
Asthma	CCL3, CCL4, CCL5, CCL7, CCL8, CCL11, CCL15, CCL17, CCL22, CCL24, CCL26,	CCR3, CCR4, CCR5,
Septic Shock, Anaphylaxis	CXCL1, CXCL2, CXCL3, CXCL5, CXCL6, CXCL7, CXCL8, CXCL9, CXCL10, CXCL11, CCL5	CXCR1, CXCR2, CXCR3
Arthritis (septic, rheumatoid, psoriatic)	CXCL9, CXCL10, CXCL11, CXCL12, CXCL13 CCL20 XCL1 CX3CL1	CXCR3, CXCR4, CXCR5 CCR6 XCR1 CX3CR1
Osteoarthritis	CXCL1, CXCL2, CXCL3, CXCL5, CXCL6, CXCL7, CXCL8, CXCL12, CXCL13, CCL2, CCL3, CCL4, CCL7, CCL8, CCL13, CCL5, CCL18	CXCR1, CXCR2, CCR2, CCR5
Atherosclerosis	CXCL1, CXCL2, CXCL3, CXCL4, CXCL5, CXCL8 CCL2, CCL3, CCL4, CCL8, CCL12, CCL13, CCL17, CCL22 CX3CL1	CXCR1, CXCR2 CCR2, CCR8 CX3CR1
Dermatitis & Delayed-Typed Hypersensitivity	CXCL9, CXCL10, CXCL11, CCL2, CCL3, CCL4, CCL5, CCL17, CCL20, CCL22, CCL27	CXCR3 CCR4, CCR5, CCR6, CCR10
Diabetes	CXCL9, CXCL10, CXCL11, CCL2, CCL9 CX3CL1	CXCR3 CCR2, CCR4 CX3CR1
Graft rejection	CXCL9, CXCL10, CXCL11, CCL3, CCL4, CCL5 XCL1	CXCR3 CCR5 XCR1
Inflammatory Bowel DiseaseS	CXCL9, CXCL10, CXCL11, CCL3, CCL4, CCL5	CXCR3 CCR5
Interstitial Cystitis	CXCL9, CXCL10, CXCL11, CCL3, CCL4, CCL5	CXCR3 CCR5
Multiple Sclerosis	CXCL9, CXCL10, CXCL11, CCL3, CCL4, CCL5, CCL7, CCL14, CCL15, CCL23	CXCR3 CCR1, CCR5
Myasthenia gravis, Grave's disease, & Hashimoto thyroiditis	CXCL9, CXCL10, CXCL11, CCL3, CCL4, CCL5 XCL1	CXCR3 CCR5 XCR1
Nephritis & Systemic Lupus Erythematosus	CXCL9, CXCL10, CXCL11, CXCL13 CCL2, CCL3, CCL4, CCL5, CCL8, CCL12, CCL13, CX3CL1	CXCR3, CXCR5 CCR2, CCR4 CX3CR1
Pneumonitis, Chronic Obstructive Pulmonary Disease, & Chronic Bronchitis	CXCL1, CXCL2, CXCL3, CXCL5, CXCL7, CXCL8 CCL3, CCL5, CCL7, CCL8, CCL11, CCL13, CCL24, CCL26	CXCR2, CXCR3 CCR3

The method consists of 1) exposing tissues from a mammal suffering from and inflammatory condition to several differing antibodies which bind to specific chemokines, 2) identifying level of expression of each chemokine based on binding of the each of the differing antibodies, and 3) administering to said mammal those specific antibodies which bind to the over-expressed chemokines. Additionally, the level of expression of any particular chemokine may be determined using PCR, as disclosed herein.

Antibodies of the invention may be administered directly to target tissue. For example, compositions containing the compositions containing antibodies as prepared under the heading "anti-sera preparation" can be administered intravenously, rectally vaginally, intrathecally, by inhalation, transvaginally, transurethrally or directly to tissue during surgery. The anti-sera preparations may also be placed on a solid support such as a sponge or gauze for administration to the mucosa. The antibodies may also be administered using microspheres or liposomes. The compositions for administration are prepared in the usual pharmaceutically acceptable carriers such as saline, water, buffered saline, glucose in saline, etc.

Liquid compositions will most often be prepared containing .1 to 1000 μ g of antibody in each ml of solution. All compositions will be administered in an inflammatory inhibiting effective amount with the amount of dosage given depending on the size and condition of the individual in need of anti-inflammatory treatment.

What is claimed is:

1. A method of inhibiting inflammation by administration of a antibodies or antigen-binding fragments which binds at least one mammalian chemokine chosen from
5 CXCL9, CXCL10, CXCL11, CCRL1, CCRL2, CCR5, CCL1, CCL2, CCL3, CCL4, CCL4L1, CCL5, CCL7, CCL8, CCL14-1, CCL14-2, CCL14-3, CCL15-1, CCL15-2, CCL16, CCL19, CCL23-1, CCL23-2, CCL24, CCL26, CCR6, CCL20, CCL25, CCL25-1, CCL25-2, and CCR10 by administration to a mammal in
10 need of anti-inflammatory intervention, of an inflammation-inhibiting effective amount of said antibodies or antigen-binding fragments in a pharmaceutically acceptable carrier.
2. The method of claim 1 wherein the carrier is a liquid.
- 15 3. The method of claim 1 wherein said mammal is human.
4. The method of claim 1 wherein the carrier is a solid support.
5. The method of claim 1 wherein said antibodies or antigen-binding fragments are derived from a human, human-
20 ized, chimeric antibody.
6. The method of claim 1 wherein said antibodies or antigen binding fragments are administered directly to tissue showing an inflammatory response tissue.
7. A method of treating a mammal with inflammatory disease
25 by the steps of:
 - 1) exposing tissues from said mammal to differing antibodies which bind to specific chemokines,
 - 2) identifying level of expression of each chemokine based on binding of the each of the differing antibodies,
30 ies, and
 - 3) administering to said mammal those specific antibodies which bind to the over-expressed chemokines.
8. The method of claim 7 wherein, in step 3, the antibodies are administered directly to the affected tissue.
- 35 9. The method of claim 7 wherein, in step 3, the antibodies are administered parenterally.
10. The method of claim 7 wherein the antibodies are admin-

istered in a liquid carrier.

11. The method of claim 7 wherein the antibodies are administered on a solid support.

12. A method of treating a mammal with inflammatory disease by the steps of:

1) identifying the level of particular chemokines using PCR,

2) administering to said mammal those specific antibodies which bind to the over-expressed chemokines in a pharmaceutically acceptable carrier.

13. The method of claim 12 wherein the antibodies are administered directly to the affected tissue.

14. The method of claim 12 wherein the antibodies are administered systemically.

15. The method of the invention wherein the antibodies are administered on a solid support.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ANTI-CHEMOKINE AND ASSOCIATED RECEPTOR ANTIBODIES AND USES FOR INHIBITION OF INFLAMMATION.

(57) Abstract: It is possible to inhibit inflammatory processes by administration of antibodies to chemokines. Identification of chemokines which are over-produced makes it possible to block specific chemokine activity using antibodies to the over-expressed chemokines.

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International application No.

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A. CLASSIFICATION OF SUBJECT MATTER

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 424/130.1; 435/7.1; 530/387.1; 514/2

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Please See Continuation Sheet

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,329,510 B1(QIN et al.) 11 December 2001 (11.12.2001), column 2, lines 45-65; column 4, lines 5-23; column 5, lines 31-46; column 13, line 10-column 14, line 45; column 25, line 5-column 26, line 31; column 27, line 28-column 28, line 67; column 28, lines 37-45; column 29, lines 1-11 and column 29, lines 12-55.	1-15

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

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